

IN THE CLAIMS:

1 1 (currently amended). A method of manufacturing a semiconductor device having
2 a thyristor and a substrate with an upper surface, the method comprising:
3 forming a thyristor having a body and a control port capacitively coupled to the
4 thyristor body, the body including an emitter region below the upper surface of the
5 semiconductor substrate; and
6 forming a conductive shunt with at least a portion located inside the substrate and
7 extending between a node at the upper surface of the substrate and the emitter region.

1 2 (original). The method of claim 1, further including:
2 forming a pass device having first and second source/drain regions separated by a
3 channel region and a gate capacitively coupled to the channel region, the first
4 source/drain region being electrically coupled to the emitter region via the node at the
5 upper surface of the substrate.

1 3 (currently amended). ~~The A method of claim 2 of manufacturing a~~
2 semiconductor device having a thyristor and a substrate with an upper surface, the
3 method comprising:
4 forming a thyristor having a body and a control port capacitively coupled to the
5 thyristor body, the body including an emitter region below the upper surface of the
6 semiconductor substrate;

7 forming a conductive shunt with at least a portion located inside the substrate and
8 extending between a node at the upper surface of the substrate and the emitter region; and
9 forming a pass device having first and second source/drain regions separated by a
10 channel region and a gate capacitively coupled to the channel region, the first
11 source/drain region being electrically coupled to the emitter region via the node at the
12 upper surface of the substrate;

13 wherein forming a conductive shunt comprises:
14 etching a trench in the substrate and adjacent to the emitter region;
15 lining the trench with an electrically insulative material; and
16 forming a conductive shunt material in the trench and electrically coupled to the
17 emitter region and to the first source/drain region.

1 4 (original). The method of claim 3, wherein forming a thyristor having an emitter
2 region in the substrate includes implanting the emitter region via a bottom portion of the
3 trench, prior to forming the conductive material in the trench.

1 5 (original). The method of claim 3, further including removing a portion of the liner at
2 a bottom of the trench, prior to forming the conductive material in the trench, wherein
3 forming a conductive material in the trench and electrically coupled to the emitter region
4 includes forming the conductive material electrically coupled to the emitter region via a
5 portion of the trench where the liner has been removed.

1 6 (original). The method of claim 3, wherein etching a trench in the substrate and
2 adjacent to the emitter region includes etching a trench around a portion of the thyristor.

1 7 (original). The method of claim 6, wherein forming a thyristor having a body and a
2 control port includes forming the control port in the trench, further including forming
3 insulative material in the trench and between the control port and the conductive shunt,
4 the insulative material being configured and arranged to electrically insulate the
5 conductive shunt from the control port.

1 8 (original). The method of claim 3, wherein lining the trench with an electrically
2 insulating material comprises:
3 filling the trench with the electrically insulating material; and
4 removing a portion of the electrically insulating material from the trench and
5 thereby forming a lined trench.

1 9 (original). The method of claim 8, wherein removing a portion of the electrically
2 insulating material includes exposing a portion of a bottom of the trench and wherein
3 forming a conductive material in the trench and electrically coupled to the emitter region
4 includes forming the conductive material electrically coupled to the emitter region via the
5 exposed portion of the bottom of the trench.

1 10 (original). The method of claim 3, wherein etching the trench includes etching a
2 trench extending into the emitter region.

1 11 (original). The method of claim 3, wherein forming a conductive material in the
2 trench includes depositing polysilicon in the trench and subsequently doping the
3 deposited polysilicon.

1 12 (original). The method of claim 3, further including etching a shallow trench
2 isolation (STI) region in the substrate, prior to etching the trench adjacent to the emitter
3 region, wherein etching the trench adjacent to the emitter region includes etching a
4 portion of the substrate below the STI region and using said portion of the substrate
5 below the STI region to inhibit lateral diffusion of the conductive shunt material.

1 13 (original). The method of claim 3, wherein etching a trench in the substrate and
2 adjacent to the emitter region includes etching a trench having a varied depth with a
3 greater depth below the STI region, relative to portions of the trench not below the STI
4 region.

1 14 (original). The method of claim 3, wherein forming a thyristor comprises:
2 forming a trench in the substrate;
3 implanting the emitter region via a bottom portion of the trench;
4 forming a first base region in a portion of the substrate adjacent to the trench and
5 electrically coupled to the emitter region;
6 forming a second base region electrically coupled to the first base region;
7 forming a second emitter region electrically coupled to the second base region;
8 and

9 forming a control port in the trench and capacitively coupled to at least one the
10 first base region and adapted to form a conductive channel between the emitter regions in
11 response to a voltage being applied thereto.

1 15 (original). The method of claim 14, wherein forming the control port comprises:
2 forming a dielectric on a sidewall of the trench; and
3 forming the control port in the trench and capacitively coupled to at least one of
4 the first and second base regions via the dielectric.

1 16 (original). The method of claim 15, wherein forming a trench includes forming a
2 trench around a portion of the substrate including the first base region and wherein
3 forming the control port and forming the conductive shunt includes forming the control
4 port and the conductive shunt in different portions of the same trench and electrically
5 isolating the control port from the conductive shunt.

1 17 (original). The method of claim 1, further including out diffusing material from the
2 conductive shunt to form the emitter region.

1 18 (original). A method of manufacturing a semiconductor device including a substrate
2 having an upper surface, the method comprising:
3 forming a vertical thyristor in the substrate, the vertical thyristor including a
4 thyristor body and a control port, the body having an N+ emitter region in the substrate
5 and below the upper surface, a P base region on the N+ emitter region, an N base region

6 on the P base region and a P+ emitter region on the N base region, the control port being
7 separated from the P base region by a dielectric and configured and arranged to
8 capacitively couple a signal to the P base region via the dielectric in response to a voltage
9 applied thereto for controlling current flow in the thyristor;
10 forming an N+ conductive shunt electrically connected to the N+ emitter region
11 and extending between the N+ emitter region and the upper surface; and
12 forming a pass device having first and second N+ source/drain regions separated
13 by a channel region and a gate capacitively coupled to the channel region, the first N+
14 source/drain region being coupled to the conductive shunt.